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Educating Young Adults about Sustainable Development

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EDUCATING YOUNG ADULTS ABOUT SUSTAINABLE DEVELOPMENT

Abstract

This qualitative study on the types of environmental education on different age groups was conducted in Lincoln, Nebraska. The purpose of this thesis is to identify what age group and educational methods would be most effective to educate Lincoln citizens on the importance and benefits of sustainable development. Environmental education is an important aspect in implementation of new, environmentally friendly ideas.

Lincoln environmentalists are working to improve the city's sustainability. Finding a way to consistently educate Lincoln residents on the importance and benefits of sustainable development will increase the public's awareness of their efforts, leading to a greater interest in the programs, increasing the amount of sustainable development throughout the city.

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Acknowledgements:

I would like to thank the University of Nebraska-Lincoln Library for giving students access to full-text, academic articles online through subscriptions to search engines and Mark Wilson, Secondary Principle of Lincoln Christian High School, for agreeing to meet with me and discuss his school's science curriculum, sustainable efforts, and potential areas for further implementation. I would also like to thank Dave Gosselin and Sara Cooper for all of their patience, hard work, and advice throughout this process, my family and friends for their continued support and encouragement, and my roommates for putting up with me.

Introduction:

Increasing the knowledge of the importance and benefits of sustainable development is a key element to increasing the amount of sustainable development within the city. The purpose of this thesis is to identify educational methods that would be most effective to educate different age groups of Lincoln citizens on the importance and benefits of sustainable development.

An important aspect in the implementation of sustainable development, "development that meets the needs of the present without compromising the ability of future generations to meet their own needs," in urban areas is environmental education (Non-Governmental Organization [NGO] Committee on Education, N.D.). There are many examples of sustainable development activities that can be implemented in urban areas, some common examples are: community gardens, green rooftops, rain barrels, rain gardens, vegetative buffers, and permeable pavements (Miller, 2005). Environmental education is "educating 'for' the environment with strategies that promote critical thinking over knowledge transmission, investigation over indoctrination, and collaborative, local, science-based solutions over advocacy-driven measure" (Short, 2010).

In 2009, Lincoln, Nebraska's mayor created an initiative, 'Cleaner Greener Lincoln,' which supports and promotes living sustainably (City of Lincoln Nebraska, N.D). Some of the small scale sustainable development that has been implemented includes; municipal lighting upgrades, non-profit energy improvements, clean energy production, and green building practices. Lincoln offers several sustainable development projects that the public able to implement at home. These programs include: recycling, rain gardens, rain barrels, and composting (City of Lincoln Nebraska, N.D.). Unfortunately, most of the public remain unaware of the city's efforts to implement sustainable development.

Lincoln environmentalists are working hard to improve the city's sustainability. They are looking for better ways to increase the public's awareness and educate Lincoln residents about the importance and benefits of sustainable development. The goal of enhanced awareness is to increase interest in sustainability programs and of sustainable development practices throughout the city.

The goal of this study was to investigate approaches that Lincoln could use to more effectively educate residents about the importance and benefits of sustainable development using environmental education. Environmental education is an important aspect in implementation of new, environmentally friendly ideas. Environmental education not only teaches about the local environment, but also about how the local environment affects, and is affected by, the global environment. Environmental education is also considered to be one of the two precursors of education for sustainable development (Chatzifotiou, 2006).

People need to have some understanding of the natural system within which they live and how they alter it before they can learn how they can improve the system and how that improvement will benefit themselves. As several of the sustainable development opportunities available for Lincoln residents involve prevention of rainwater runoff, residents would need to have an understanding of the water cycle.

Materials and Methods:

A qualitative analysis of current literature on studies that examined different types of environmental education on multiple age groups was conducted. The results of this examination were then analyzed to determine the extent to which different methods for different age groups may be most effective to increase sustainable development knowledge in Lincoln residents.

The studies included in the literature review were found using the Academic Search Premier (EBSCO) online database available to all University of Nebraska- Lincoln students through the University Library. The search focused on how to teach different types of environmental education to different age groups. As many sustainable development programs in urban areas focus on preventing, or slowing, rainwater runoff; water education studies were analyzed alongside general environmental education and sustainable development education studies. Key words used in the literature search were; 'water education,' 'environmental education,' and 'education and sustainable development.'

A personal interview was conducted by the author to discover what local schools were currently doing to enhance environmental education. The interview also inquired about the school's teaching style, curriculum, and types of environmental organizations. The interviewee was the secondary principle at Lincoln Christian High School (Lincoln Christian). Lincoln Christian is a private school that has already begun implementing sustainable development and was chosen because it seemed to be interested in the idea of sustainable development. The list of questions and answers from the interview are in Table 2.

Results of Literature Review:

The literature review is broken into two different sections, the first describing the study and the second describing the results of the study presented. Articles that contain similar subject matter are grouped together and summarized in Table 1. The groups include: Adults and Teaching, Children and Teaching Methods, and Perceptions and Challenges for Educators.

Adults and Teaching

Cockerill (2010) conducted a water education program for adults in North Carolina. As part of the program, adults were asked to complete pre- and post-tests about basic water facts. They were also asked to state; what they liked about the program, what could be improved, and what issues they have with current adult environmental education programs. Through these surveys, Cockerill concluded that scientists use too much jargon and technical language when communicating with the public about environmental issues. Cockerill's program defined scientific terms and used everyday language to educate his audiences about the water cycle and basic water conservation methods. The program was conducted at town meetings and other public gatherings. The results of the study can be found in Table 1.

Children and Teaching Methods

Covitt et al. (2009) investigated how the informal knowledge, current knowledge, of students differed from accepted scientific knowledge. The study used questionnaires to gage the current knowledge of 40 students from each type of school, elementary (3^{rd} & 5^{th} grade), middle (7^{th} & 8^{th} grade), and high (9^{th} to 12^{th} grade). The questions included basic water facts and the application of those facts in real-world situations (i.e. "what does water look like underground?" and "how would you make ocean water drinkable?"). By analyzing the answers to the questionnaires, Covitt et al. found that all students have some understanding of water, but are unable to grasp the holistic picture of the water cycle. Covitte et al. also found that all of the students had difficulty comprehending the atomic and landscape scales of the water cycle. However, as the age of the students increased (went from elementary to middle to high), the responses indicated more knowledge of the landscape and microscopic scales. Covitt et al. concluded that all students had difficulty understanding the complexity of the water cycle because they are unable to physically see water moving through pore spaces or visualize how the whole system works, but that the ability to visualize the whole system increased with age. The lack of visualization separates what students learn in the classroom from their knowledge of the environment around them. Covitt et al. believes that better curriculum is needed to show students of all ages how in class lessons directly relate to what is occurring within their environment.

One worldwide environmental education program is Project WET (Water Education for Teachers). "Project WET is a multifaceted program that includes: research-based material development, educator training and instruction, networking, and evaluation" with the goal of promoting: awareness, appreciation, knowledge, and stewardship of water resources through developing water-related teaching aids for educators (D'Agostino et. al. 2007). D'Agostino et al. investigated the Project WET program in regards to the quality of the education it gives students in traditional classrooms. The study focused on how 6^{th} graders knowledge of subject

material increased after their teacher used lessons from Project WET to supplement the water curriculum. All of the study subjects learned about the water cycle, but only half learned about water in relation to weather using lessons from Project WET. The other half learned about water and land.

The participating 6th grade teachers had never used Project WET before and were trained on how to use the program effectively prior to the study. Pre- and post-tests were analyzed to determine the results of the study. Because Project WET engages students in the curriculum through small group interactive education (lessons that involve class participation in the forms of games, skits, stories, or experiments), it was predicted that each group would outperform each other on the post-test. From the results of the post-test, it was determined that group membership explained 16% of the land group's outperformance on the land-based questions and that group membership explained 25% of the weather group's outperformance on their perspective questions. Teachers using Project WET can deliver effective lessons leading to student learning because the program materials are flexible. Because first time users of the program can successfully educate students on the water related subjects, the study concluded that the program was effective when used in traditional classrooms alongside environmental curriculum.

Middlestadt et al. (2001) conducted a qualitative study in Jordanian schools on water conservation education to investigate how different young adults (10th graders with the average age of 15.6 years) learn about water and how the education impacted their community. Their study looked at how young adults' actions changed after learning the importance of water conservation with interactive (hands-on) education. There were two different groups of students involved in the study; a group that was educated in local schools using lecture based education (control group) and a group that was educated by local environmentalists using interactive education (experimental group). There was an equal proportion of boys and girls in each group. Middlestadt et al. surveyed each group's water conservation before and after receiving water education. The lessons focused on water availability by increasing awareness of how the climate, environment, and human populations affect water availability. The results of these surveys showed that all students changed their water usage after receiving the education, but that the experimental group decreased their water consumption more. Sixty-four percent of students in the experimental group stated that they were actively seeking ways to reduce household water consumption, compared to only 38% of students in the control group. Parents of both classes decreased their water use based on the recommendations their children brought home with them. An example of this is that 73% of mothers of children in the experimental group collected and washed clothes at one time, compared to 64% of the control groups' mothers.

He (2010) investigated environmental education in rural Chinese schools by conducting a series of environmental education activities throughout China about local biodiversity hotspots. In one of these studies, He (2010) demonstrated how a community can affect local water quality by telling a story about the community's interaction with a local lake and having students act as different members of the community. A discussion followed the story and explained local connections to the environment and how individuals in a community can positively, or negatively, impact the environment. During the discussion He suggested different ways the community could improve the situation. Each class was developed around actual circumstances that occurred in each local community. , Students were more likely to accept the education when the lessons concerned local issues. As each lesson was designed, the traditional culture of the community and the ecological environment were studied and researched, before being implemented in the lesson plan. He also added environmental teachings from local culture to lectures showing the connection between the environmental education and the community's beliefs. Long-term environmental education from teachers with a scientific understanding of the environment was required for students to obtain maximum benefits from environmental education. He discovered that exam-oriented education was still mainstream in China and that reliance on test scores needed to be lessened in order for environmental and sustainable education to be fully effective.

Some suggestions to implement long-term environmental education consisted of organizing members of the community on weekends to engage in environmental activities and using traditional festivals to write and rehearse interesting activities related to environmental topics. It is important to encourage children to share the knowledge they learn with adults because children have a major impact on the community. He also found that allowing children to research the quality of their own environment and propose solutions to environmental issues stimulated the students' initiative, increased their ability to take action, and enhanced their confidence in taking part in environmental protection.

Perceptions and Challenges for Educators

A qualitative study conducted by Blackwell et al. (2003) investigated the paradoxes of education in schools. They believed that that the way teachers viewed themselves affected the quality of education and conducted a qualitative study to test their theory. Blackwell et al. analyzed the view of society on teachers and how teachers view themselves in their profession. They then tied this to how well the teachers transfer knowledge to their students. The study found that there was a connection between how prepared teachers felt and how well they taught. During the industrial revolution, schools adapted 'scientific management' standards (a very detailed outline of exactly what should be taught when) to make it easier to staff classrooms and deal with high teacher turnover and shortages in large cities. One of the goals

of the 'scientific management' standards was to limit the amount the teacher had to think and make decisions about their job. At the time, men were viewed as professionals and able to make decisions, so were in charge of supervising and training the teacher, who were women. This led to males perceiving themselves as superior to women, making them more confident in their jobs. Although gender equality is greater now, Blackwell et al. discovered that male educators were still more confident that females. As the age of a teacher increases, the amount of experience the educator has also increases. Blackwell et al. found that older teachers with more experience perceive themselves as being more confident and more effective educators than younger, more inexperienced teachers. They found that the more confident teachers had higher student test scores and that the community was more satisfied with their teaching methods.

Gruver and Luloff (2008) conducted a qualitative study looking at the water cycle curriculum in Pennsylvania schools. Pennsylvania has recently mandated that all students be taught about the environment and how it pertains to Pennsylvania. Gruver and Luloff wanted to investigate how confident non-environmental teachers were in educating their students about the water cycle. They found that educators felt unprepared to teach their students on the subject because the available curriculum was too broad and hard to acquire. Even though the state suggested a few educational programs designed to educate teachers on how to teach about the environment, they required too much time for the teachers to participate in, causing most teachers to obtain their curriculum from the internet or other educators. Teachers became frustrated with the new, environmental curriculum because they did not have any experience implementing it. Teachers in this study altered their old curriculum to fit their teaching style. They also altered it based on the feedback from students. Without having used the new curriculum before, teachers were unable to change it to fit their respective teaching styles of to fit the needs of their students, causing frustration and lack of confidence. Gruver and Luloff's study also concluded that when educators are confident in the material they are teaching, the quality of the education increases, which confirms Blackwell's study.

Rickinson and Lundholm (2008) conducted a qualitative analysis of two different studies concerning how students respond to learning activities focused on environmental issues. The first study that they analyzed focused on the teaching and learning of environmental issues within English secondary school geography lessons. This study investigated:

> "the ways in which environmental curriculum topics were being taught by the teachers and the thinking that lay behind these practices; the way in which such teaching was experienced by their students; and the similarities and/or differences between the perspectives of the teachers and the students" (Rickinson and Lundholm, 2008).

The second study that Rickinson and Lundholm (2008) analyzed investigated Swedish university students' learning about separate environmental issues as part of an undergraduate program in civil engineering, biology, and doctoral environmental research. Three kinds of learning challenges for students which lead to negative outcomes during environmental learning activities were identified as (Rickinson and Lundholm, 2008):

(1) different emotional responses to the content- students' learning experiences are shaped by an emotional reaction to an aspect of the topic being studied;

(2) different opinions about the content as compared with the teacher/lecturer- where there is some kind of conflict between the beliefs or views of a student and the beliefs or views of the teacher/lecturer; and

(3) different views of what should be studied in a subject- where students feel that a certain types of task or content is not appropriate for them to be studying within a particular subject".

Rickinson and Lundholm also found that the secondary students' struggled with not having a strong enough opinion about a topic, whereas the university students struggled with having an opinion that conflicted with the opinion of the lecturer. Teachers/lecturers need to be aware of strong emotional reactions among students about environmental issues because these can influence the nature and depth of the student's involvement. Rickinson and Lundholm (2008) discovered that environmental educators need to be aware that the similarities or differences between their own views and those of their students can be problematic for learning and engagement. An instructor cannot assume that the students will share their beliefs.

Tenam-Zamach (2009) examined the discourse of the national, state (Florida), and local science content standards to determine how many times each text referred to environmental sustainability. The study focused on the science content standards guiding seventh grade science curriculum. National and state (Florida) documents and a seventh grade textbook were read to assess how many times and in what context environmental sustainability appeared. Tenam-Zamach found that the local textbook contained more environmental sustainability terms than the state and national curriculum documents, which presented the science content from an anthropocentric perspective. Tenam-Zamach recommends that the national and state standards be revised to include a focus on the idea that humans are in integral part of the environment. Because the state standards closely resembled the national standards, a revision of the national standards was proposed, which would increase environmental sustainable education in all states. It was also recommended that the individuals involved in developing the national science curriculum be diligent in including environmental sustainability concepts.

In the early 1990s England integrated environmental education into their curriculum as part of several core subjects and by the late 1990s, environmental education it was its own subject (Chatzifotiou, 2006). Recently, the English national curriculum has begun using the term 'education for sustainable development' ("education to enable sustainable development") to describe their additions to the environmental education curriculum (Esa, 2010). Chatzifotiou (2006) investigated the environmental education program in English primary schools and how similar 'education for sustainable development' is to the current environmental program. Chatzifotiou found that primary school teachers in England regarded environmental education as a teaching procedure concerned mainly with the transmission of knowledge (education about the environment). The English teachers were most concerned that their students should develop positive attitudes towards the environment and that environmental education create citizens who behave responsibly towards the environment. These teachers felt that environmental education was an intrinsic part of the curriculum and school life. Chatzifotiou also found that teachers had difficulty with what 'education for sustainable development' meant and what they are expected to teach. Without understanding what 'education for sustainable development' is and what they are unable to teach, teachers are unable to instill environmental knowledge in their students.

Esa (2010) investigated the environmental knowledge, attitudes, and practices of biology student teachers, teachers in their last year of education. Esa believed that it is important for teachers to understand their role in educating students for a sustainable future. This understanding requires teachers to have a complete understanding of education for sustainable development and how to incorporate it into their teachings. The study found that teachers who are environmentally literate and practice environmental sustainability are more likely to influence their students to be interested in the environment. The student teachers in this study demonstrated a thorough knowledge about the environment, environmental concepts, and had positive attitudes towards the environment. Esa believes that the high correlation between environmental knowledge and attitudes suggest environmental knowledge and attitudes are directly related to each other. It was suggested that improvements in environmental and sustainable education should begin with the re-education of teachers.

Table 1: Results of Literature Review

Table of Literature Results			
Adults and Teaching			
Author	**Age Studied**	**Study Subject**	**Results**
Cockerill (2010)	Adults: Average Citizens	Adult Water Science Education	▪ Adults are eager to learn ▪ Adults do not understand scientific jargon or technical language ▪ Urban and rural residents find environmental education useful ▪ Adults have a difficult time making regular meetings ▪ Discussion is a key component in reinforcing the importance and relevance of the topic among adults ▪ Engaging in discussions with peers and technical experts increases adult learner interest in the topic and can lead to more informed decision making

Children and Teaching Methods			
Author	**Age Studied**	**Study Subject**	**Results**
Covitt et al. (2009)	Children and Young Adults: 40 Elementary (3rd & 5th grade), 40 Middle School (7th and 8th grade), 40 High School (9th-12th grade)	Difference Between Curricular goals for Water Science and What Children Actually Learn	▪ All students have some understanding of water cycle ▪ Most students are unable to grasp the holistic picture of the water cycle ▪ Many students have difficulty comprehending the atomic and landscape scales of the water cycle ▪ Elementary students fail to grasp the complexity of the water cycle because they are unable to physically see water moving through pore spaces or visualize how the whole system works ▪ Middle and high school students demonstrated a higher ability to visualize the whole system than elementary students ▪ Lack of visualization separates what students learn in the classroom from their knowledge of the environment around them ▪ Better curriculum is needed to show students how in class lessons directly relate to what is occurring within their environment
D'Agostino et al. (2007)	6th Grade Children	Quality of Education from Project WET in Traditional Classrooms	▪ Succeeds in engaging students in the curriculum itself ▪ Engagement increases the amount of knowledge the students retain ▪ Program is effective when used in traditional classrooms alongside environmental curriculum

Middlestadt et al. (2001)	10th Grade Young Adults with the Average Age of 15.6 Years	Water Conservation Education in Jordanian Schools	▪ Boys and girls both increased their water conservation efforts after receiving their education ▪ Young Adults who received hands-on education increased their conservation efforts more than children who received lecture-based education ▪ Parents of all participants increased their conservation efforts ▪ Parents of those who received hands-on education increased their conservation efforts more than parents of participants who received lecture-based education
He (2010)	Elementary and Secondary Students	Elementary Environmental Education Suited to Local Conditions in China	▪ Lessons concerned with local issues increase the success of environmental education ▪ The culture of the community should be incorporated into the environmental lesson plans ▪ When able, lesson plans should include messages from the local culture (i.e. religion, traditional beliefs, etc.) ▪ Long-term environmental education is required to maximize sustainable practices and knowledge ▪ Nations need to steer away from exam-based education and include environmental education ▪ Teachers could engage students and members of the community in environmental education on weekends ▪ Encouraging children to share their knowledge to their parents spread the lessons throughout the community ▪ Children are stimulated when they are able to research environmental problems and solutions on their own

Perceptions and Challenges for Educators			
Author	**Age Studied**	**Study Subject**	**Results**
Blackwell et al. (2003)	Adults: Teachers	Paradoxes of Education in Schools	▪ The way teachers view themselves affects how well they teach ▪ As teacher's age is directly related to their confidence and how well they teach ▪ Male teachers tend to be more confident teachers ▪ Teacher confidence is directly related to how well they teach
Gruver and Luloff (2008)	Adults: Middle and High School Teachers	Mandated Water Cycle Curriculum in Pennsylvania Schools Taught by Non-Environmental Teachers	▪ Teacher's feel unprepared ▪ Available curriculum is too broad and difficult to access ▪ State educational programs for teachers require too much time for teachers to participate in ▪ The majority of teachers obtained their curriculum from the internet or other educators ▪ When educator's are confident in the curriculum the quality of education increases ▪ New curriculum often frustrates and lowers teacher's confidence from lack of experience implementing it ▪ Understanding teacher concerns (how to effectively implement the new curriculum) is crucial before new curriculum is added

Rickinson and Lundholm (2008)	Young Adults 13-15 Years Old and College Students 20-45 Years Old	Student's Learning Challenges in Environmental Education	▪ When teaching environmental topics, instructors need to be aware of the potential conflicts stated below: ▪ High school and college students experience different emotional responses to the content ▪ High school and college students' learning experiences are shaped by their emotional reactions ▪ High school and college students may have different opinions about the environmental content than their teachers ▪ High school and college students may have different ideas of what should be studied in a subject than their educator ▪ Secondary students struggle with not having a strong opinion on a topic University students struggle with having an opinion different than their instructor
Tenam-Zamach (2009)	No Individuals were Studied	Themes of Environmental Sustainability in National, State (Florida), and Local Curricular Content (*Glencoe Science Florida Science: Grade 7*)	▪ Local text books contained the greatest amount of sustainable development concepts ▪ State (Florida) curricular documents closely resemble national curricular documents ▪ National and state (Florida) science content focuses on anthropocentric perspectives ▪ National and state (Florida) standards need to be revised to include a focus on the idea that humans are in integral part of the environment ▪ Individuals involved in developing the national science curriculum need to be diligent in including environmental sustainability concepts

Chatzifotiou (2006)	Primary School Teachers	Environmental Education in England	▪ Primary teachers in England regard environmental education as being concerned mainly with the transmission of knowledge ▪ Teachers are most concerned that their students should develop positive attitudes towards the environment ▪ Teacher's goal is to create citizens who behave responsibly towards the environment ▪ English teachers feel that environmental education is an intrinsic part of the curriculum and school life ▪ Teachers have difficulty understanding what sustainability is and how they should teach it
Esa (2010)	3rd Year Student Teachers	Environmental Knowledge, Attitudes, and Practices of Student Teachers	▪ Teachers need to understand their role in educating students for a sustainable future ▪ Teachers need to have a complete understanding of education for sustainable development and how to incorporate it into their teachings ▪ Environmentally literate teachers who practice environmental sustainability are more likely to influence their students to be interested in the environment ▪ Environmental knowledge is directly related to environmental attitude ▪ Environmental and sustainable education improvements should begin with re-educating teachers

Results of Interview:

Table 2: Interview Questions and Responses (Personal Interview, 2011)

Interview Questions and Responses	
Question	Answer
1. Are there any examples of environmental after-school programs at Lincoln Christian?	○ The most Lincoln Christian has done is cleaning up trash at near-by bike trails to complete mandatory volunteering hours ○ Small schools need a teacher to promote after school programs
2. Do you feel that there is an interest in an environmental club at the school?	○ There is an interest, but students are already very involved ▪ In a large school you have a need for clubs ▪ In a small school you don't have a need because all students are able to participate in sports and other activities ○ It takes a teacher passionate about the subject to motivate and excite the students and form a successful club
3. How are the students currently exposed to the environment (i.e. is there any recycling at the school, do the students learn outside)?	○ Have had recycling in classrooms, phone book recycling ○ American government teacher, Peter Grothouse, put in for a grant to work with outdoor science lab for middle and high school students ▪ The outdoor lab would teach some environmental issues ○ Have a butterfly garden that k-12 students have access to ○ Within the curriculum, teachers have free reign to go outdoors, but need to stay on campus
4. Does the school have any examples of sustainable development on campus? If so, do you teach students about what it is and how it benefits the school and environment?	○ Yes, the city put a rain garden in the front of the school about 2 years ago ○ They talk about it in science classes, but do not teach every student the benefits they are receiving from the rain garden or why it was put in ○ There is a plaque explaining the garden, but it is up to students and other visitors to read it to learn about the garden
5. Do you have a good response to your environmental/sustainable development efforts?	○ Pretty good response with the recycling program ▪ Kids need incentive programs to increase turnout

6. Can a volunteer begin an afterschool club at Lincoln Christian?	○ Yes, but they would have to be a Christian (because it is a Christian High School and they value the morals that the Christian faith instills in its followers)
7. Does your curriculum contain any natural science classes? Do teachers utilize the grounds in their teaching?	○ Middle and high school has natural sciences as part of biology ○ 4th grade goes outside more
8. Do you think that environmental and sustainable development education could be integrated into the current curriculum?	○ It is possible to integrate some into the curriculum ○ Biggest obstacle will be ACT/SAT ▪ Students focus their efforts on performing well on these tests
9. How many sciences classes are required and what are those sciences?	○ Currently, ▪ Only require 2 science classes, but most take 3-4 ▪ Physical and biological sciences are required and both contain lab periods ○ However, the state is now requiring 3 years of science starting with 2014 graduates ▪ This is going to be a problem for the school ▪ Lincoln Christian does not have any academic requirements to attend ▪ Some students go to the military or trade schools immediately after graduation and are not concerned about subjects that do not readily pertain to their future careers
10. Do you feel that students learn better from hands-on education or traditional, text-based, education?	○ Depends on the students, so there should be a mix ○ The tests should reflect the type of lesson that was given ▪ i.e. if the lesson was hands-on, then the test should be hands-on ▪ However, if the written exam is written right, it can correctly reflect how much the students learned through a hands-on lecture ○ Lincoln Christian conducts lab practicals ○ Virtual teaching (videos, computer animations, computer modeling) can be used to supplement lecture-based education if hands-on learning is not practical (i.e. show an animation about volcano erupting instead of describing it)
11. How long are class periods and when does school end?	○ 50 minute class periods ○ School ends at 3:33pm

12. What is the average yearly percentage of your students attending college, trade school, and going into the military after graduation?	○ ~95% attend college ○ Military and trade schools depend on the year, sometimes there is more interest in one of these, but the average is ~5% for both of them together
13. How do you prepare your students for the direction that they want to take (college, trade school, military)?	○ Counselors start meeting with the students in the 8th grade ▪ They complete personality tests, find their interests, discover talents, etc ○ Most students feel prepared for their after graduation plans (college, trade school, military) when they graduate

Discussion:

Age Group and Teaching Methods

The specific objective of this thesis was to investigate appropriate methods to effectively educate Lincoln citizens on the importance and benefits of sustainable development. The literature indicates that children under the age of 13, young adults, 13-18, and adults over the age of 18 responded differently to environmental based education. Adults are primarily interested in local environmental education, education about local issues and how the local environment is affecting those issues (Cockerill, 2010). Discussion based learning is the most effective method of facilitating environmental education in adults. As adults find it difficult to meet regularly, consistently engaging this age group in environmental education is not possible. Therefore, adults would not be an affective age group to focus environmental education for sustainable development in Lincoln, Nebraska.

Children under the age of 13 have the greatest influence over the behaviors of their parents and community members (He, 2010). However, they have the most difficulty understanding the complexities of the systems in the environment (Covitt et al., 2009). They have not had the curriculum or have the ability to understand environmental interactions on scales that they are unable to physically see, preventing them from fully understanding how sustainable development would benefit the environment and the community and fulfilling our goal (Covitt et al., 2009).

Children over the age of 13 still influence their parents and community (Middlestadt et al., 2001). They also are able to understand the complexities of environmental systems and form connections between classroom lessons and real-world situations (Covitt et al., 2009). The required amount of secondary science courses is increasing in Nebraska, providing a need for more science classes, especially for students not continuing their education after graduation

(Wilson, 2011). This age group would be the ideal age to teach about the importance and benefits of sustainable development as the education would still be forwarded to adult members of the community, the students are able to comprehend the complex systems needed to understand the benefits of sustainable development, and there is currently a need for more science classes for non-science students (students not continuing with scientific fields after graduation).

Interactive education was found to benefit students of all age groups (D'Agostino et al., 2007; Middlestadt et al., 2001). Interactive education was found to increase conservation methods in both participants and participants' parents (Middlestadt et al., 2001). Project WET is an example of an interactive program that can be used to implement hands-on education within the current curriculum (D'Agostino et al., 2007). Lincoln educators are encouraged to implement hands-on education in their lessons in order to effectively educate all types of students (Wilson, 2011). Because the opportunity is available to Lincoln educators, implementation of interactive education concerning environmental education is recommended for Lincoln schools.

Perceptions and Challenges for Educators

There are a variety of perceptions and challenges that educators need to address to effectively educate people about the environment. One of these challenges is that teachers' ideas and beliefs concerning environmental issues may differ from their students, causing students to not fully engage in topic and preventing the transfer of knowledge (Rickinson and Lundholm, 2008). This difference should be acknowledged by the educator who should try to express to their students that differing opinions, and even indifference, is acceptable. As personal activities, knowledge, and enthusiasm about the environment influence a teacher's ability to effectively educate students about environmental topics, environmental educators should be both knowledgeable of and passionate about the environment. There are opportunities in Lincoln high schools to have non-educators lead after school environmental clubs providing a niche for local environmentalists to effectively educate a large portion of the city about the importance of sustainable development.

Lincoln schools must meet all state curricular requirements, which emphasize exam-based learning (test scores are heavily relied on) (Wilson, 2011). A way for environmental education to be regularly taught is to hold educational events after school, on weekends, and during local festivals (He, 2010). Lincoln high schools can add an environmental club to their after-school programs, which engages students by implementing small scale sustainable development, such as rain gardens or rain barrels, throughout the city. The addition of this club would increase the amount of sustainable development in the city, increase awareness of sustainable development, and encourage students to engage in sustainable practices.

Conclusions:

As the city of Lincoln begins implementing sustainable development, it is important that they educate the residents on what it is, why it is important, and how it benefits the residents. As He (2010) stated, teaching students about sustainability ensures that the lessons reach current and future homeowners through education from the students and the students own application of their knowledge. Finding the right age group to target is important for effective education.

This study found that although adults are willing to learn new things, their schedules prevent them from attending regular informational meetings. Children are not developed enough to understand many of the complex environmental systems. This leads to a disconnect between what the educator is trying to teach them, what is actually learned, and how the in-class lesson pertains to the outside world. Interactive curriculum can be used to help bridge this gap. Programs, like Project WET, are useful tools and are able to be used alongside formal curriculum, but they lack often lack connections with the local environment. High school students are the ideal age because they are old enough to understand the complexity of natural systems and still young enough to influence their parents. High school students also have a natural curiosity about how the curriculum relates to the outside, or 'real,' world. Sustainable development greatly benefits the community and areas where it is implemented. Teaching high school students about the importance and benefits of sustainable development satisfies the student's curiosity about real-world application of natural science curriculum while promoting sustainability.

Children learn best through interactive education, especially concerning environmental education, but are not developed enough to understand the true complexity of the natural system and cannot connect what they learn in the classroom to what occurs in the environment around them. Adults want to be informed of new ideas, studies, and viewpoints, but often struggle with scientific jargon and technical language. High school students are developed enough to understand the complexities of the natural system, but still young enough to attend regular meetings, such as class, and relay information to their parents, increasing the amount of education the community receives.

High school science classes provide an opportunity for older students to engage in regular environmental education programs. Local connections should be added to these lectures to further engage and educate the students. Lincoln high school students have an interest in the environment and learning about sustainable development. There are opportunities for the students to be educated about environmental topics and sustainable development, either through after school programs or through class room activities (hands-on learning, outdoor classes, virtual lessons, examples of sustainable development on campus).

The city of Lincoln should implement interactive environmental education into their current curriculum. A separate environmental class and/or environmental after-school club would be ideal to promote sustainable development throughout the city of Lincoln.

Future studies should focus their research on how to best implement environmental education in local high schools. After-school programs need to be evaluated to discover their affect on participants' knowledge of the environment and how this knowledge and participation affects their conservation efforts.

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